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Comparative study of the diagnostic value of EMG-NCV and MRI in patients with radicular pain in the neck and back

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ABSTRACT

Introduction: Spinal radiculopathy is the most common cause of back pain and pain of upper or lower limb. Radiography (MRI or X-ray) and electrodiagnostic measures, including EMG-NCV, can be employed for diagnosis of radiculopathy. Each of the mentioned diagnostic methods has its own limitations. Thus, a comparative study between these methods is essential for accurate diagnosis of patients with clinical symptoms of radiculopathy.

Methods: In this cross-sectional study, 96 patients with radicular back pain who had visited neurology clinic in Ardabil Hospital were enrolled. All the patients had MRI, EMG, and NCV results in their files so the present study did not impose any excessive costs on the patients. MRI was used as the diagnostic gold standard and other tests were compared with it. The sensitivity, specificity, positive predictive value, and negative predictive value were estimated for each test.

Findings: The results of this study indicated a relatively high diagnostic value of lumbar radiculopathy for EMG test and it had a relatively high compatibility with the results of MRI test. Unlike EMG, NCV test did not show any significant agreement with MRI results. Also it was recommended that EMG for back be done with high obsession when necessary.

Conclusions: Doing EMG test in patients with radicular pain can be a helpful diagnostic test for spinal radiculopathies and NCV test is not worth doing for diagnosis of radiculopathy of the spine.

Key words: *Radiculopathy, Electromyography (EMG), MRI, Nerve Conduction Velocity (NCV)*

Introduction

Radiculopathy is nerve root disease that may be caused by structural damage, such as disks, tumors, stroke, and vascular disorders or infections such as herpes zoster. Diabetes mellitus is a common cause of radiculopathy [1]. In adults below 45 years and above 45 years degenerative disc disease in the cervical or lumbar spine and their spinal stenosis are the most common reasons for radiculopathy in the neck and back [1-3]. Radiculopathy makes up about 2 percent of total medical admissions and its incidence is higher in men than in women [4-6].

Radiculopathy is often painful and unilateral and mostly involves C5 and C6 roots in cervical spine and L4-L5-S1 in lumbar spine [1,7]. Diagnostic procedures such as radiography (MRI or X-ray) and EMG-NCV are used to diagnose cervical and lumbar radicular pain and determine the nerve roots involved [8-9].

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EMG-NCV tests are the most important techniques for peripheral nerve activity by which we can evaluate different types of pathology of peripheral nervous system involvement, and also proximal nerves involvement can be determined via late responses of F-wave and H-reflex [8]. EMG-NCV tests are very useful in localizing the lesion area, determining the number of roots involved and differentiating network damage from multi-root damage [10].

Magnetic resonance imaging (MRI) is a noninvasive method without exposure to ionizing radiation, a selected method for evaluation of degenerative diseases of the spine, and a diagnostic procedure for detecting radiculopathy [11]. The use of MRI in diagnosis of radiculopathy can be associated with falsely positive results; hence, the use of MRI for detecting radiculopathy is a matter of controversy among specialists [12-14].

Since each of the above diagnostic methods has its own limitations, making a comparison between these procedures is essential for examination of patients with clinical symptoms of radiculopathy and accurate diagnosis of the disease, which is the aim of the present study.

Materials and Methods

This was a cross-sectional study that has been done on 96 patients admitted to a specialized neurology clinic in Ardabil who complained of radicular pain in neck or back. After the initial clinical examination by a neurologist, patients without inflammation, infection, fractures, and acute dislocations in cervical, thoracic, and lumbar spine were included in the study. Information such as demographic, physical findings, electromyography, and nerve conduction velocity and radiological findings for all samples was collected by a checklist. The collected data were analyzed in SPSS.21 using statistical methods. The significance level was considered at less than 0.05.

Results

Of all the subjects, 50 cases were male (52.1%) and the rest were female. 44 patients complained of neck pain and 52 complained of back pain. Matching the EMG and MRI outputs of 44 patients with their cervical radicular pain complaints, a significant conformity and consistency were found between the results of the two tests. The results of two tests were compatible with each other in 18 cases (40.8%). The investigations showed that in 8 cases (18.2%) both tests' results were normal, in 3 cases (6.8%), both showed mild impairment, in 3 cases (6.8%), both indicated average impairment, and, in 4 cases (9.1%), both EMG and MRI revealed severe radiculopathy in the cervical spine.

By classifying the patients into two groups "normal or mild" and "moderate or severe," the results showed significant relative conformity between MRI and EMG test results in 63.6% of cases (P = 0.029).

The obtained kappa coefficient was 0.385 which was indicator of an average and significant conformity between the cervical MRI and EMG output. Taking the results of the MRI as the gold standard, sensitivity, specificity, positive predictive value, and negative predictive value of cervical EMG test were assessed as 72.7%, 72.7%, 88.9%, and 47.1%, respectively.

Examining the compliance of NCV and MRI outputs, the compatibility between the results of the two tests was not found that noticeable; that is, the results were concordant only in 24% of cases and in other cases they were not fully and significantly matching. Considering the results of the MRI as the gold standard, sensitivity, specificity, positive predictive value, and negative predictive value of cervical NCV test were estimated as 51.5%, 36.4%, 70.8%, and 20%, respectively.

Checking the compatibility between EMG and MRI outputs showed high agreement between the results of the two tests for the patients with lumbar pain; it means that the results of two tests were thoroughly compatible only in 14 cases (26.9%). It was shown that in 6 cases (11.5%) both tests were normal, in 3 cases (5.8%) both reported slight abnormality, in 4 cases (7.7%) both tests revealed average abnormality, and in 1 case (1.9%) both EMG and MRI indicated severe spinal lumbar radiculopathy.

Classification of the patients into two groups as normal or mild and moderate or severe showed a significant relative conformity between MRI and EMG test results in 63.6% of cases (P = 0.025).

Considering the results of MRI as the gold standard, sensitivity, specificity, positive predictive value, and negative predictive value for lumbar EMG test were estimated as 56.4% 46.2%, 75.9%, and 26.1%, respectively. Compliance review of NCV and MRI outputs indicated no considerable harmony between the

results of the two tests. In other words, the test results matched completely only in 13 cases (24.9%) and in other cases there was no thorough compliance. Further investigation revealed that, in 6 cases (11.5%), both tests were normal, in 4 cases (7.7%), both of them reported mild abnormality, in 2 cases (3.8%), both tests showed moderate abnormality, and, in 1 case (1.9%), both NCV and MRI indicated severe radiculopathy in lumbar spine. Considering the results of the MRI as the gold standard, sensitivity, specificity, positive predictive value, and negative predictive value for lumbar NCV test were estimated as 59%, 46.2%, 76.7%, and 27.3%, respectively.

Discussion

This study's findings were in line with those of the majority of studies done on efficiency of EMG output in diagnosis of cervical radiculopathy in Iran and other areas around the world. In a study conducted by Chitsaz and colleagues, EMG detected cervical radiculopathy in 50% of cases, while MRI diagnosed abnormalities in 77.8 percent of patients who had visited doctor because of their cervical radiculopathy signs. Chitsaz and colleagues evaluated the diagnostic value of EMG notable [15]. Rezasoltani and colleagues' study in 2008 showed 61 percent agreement between electrodiagnostic findings and MRI [16]. In this study, the compliance of EMG and MRI indicated a great agreement on both confirming the presence or absence of abnormality and determining its severity and a significant correlation was found between the results of two medical tests. Chitsaz and colleagues, in their study, have reported the lowest sensitivity of NCV diagnostic test to cervical radiculopathy, compared to other routine tests such as MRI, EMG, and SSEP. The study showed that NCV cannot be a suitable criterion for diagnosis of cervical radiculopathy. Whereas MRI diagnosed radiculopathy in 77.8% of patients with radicular pain, NCV on the same patients could only detect abnormality in 5.6% of cases. Due to the dramatic difference between the two diagnostic tests, employing NCV test along with MRI seems vain [15]. Kimura et al., with an overview of the studies conducted around the world, reported the insignificant diagnostic value of NCV in relation to the spinal radiculopathy [17]. In the present study, the results of NCV and MRI did not match and their sensitivity and specificity in diagnosis of cervical radiculopathy were 51.5% and 36.4%, respectively. Since these tests cost patients or health system a lot of expenses, and taking the poor performance of this test into account, using NCV for diagnostic evaluation of cervical radiculopathy seems unnecessary.

The studies on the diagnostic value of EMG in lumbar radiculopathy have reported contradictory results [18-23]. Khomand et al.'s study in 2013 indicated 80.6% compliance between EMG and MRI outputs, suggesting EMG as a crucial test that should be used along with MRI in diagnosis of lumbar radiculopathy. They have also estimated sensitivity, specificity, positive predictive value, and negative predictive value for lumbar spine EMG, respectively, 68.9%, 86.3%, 81.6%, and 76%, on average [24]. Reza Soltani et al.'s study in 2008 showed 61 percent agreement between EMG and MRI findings [16]. A study conducted by Albeke et al., in 2000, estimated sensitivity, specificity, positive predictive value, and negative predictive value for EMG test to be, respectively, 62%, 37%, 66%, and 33%, and suggested employing it not only in diagnosis of sciatica but also for other purposes [25]. Hayeg et al.'s study in 2005 was undertaken with the aim of assessing the value of electrodiagnostic tests for the diagnosis of lumbar spinal canal stenosis. In their study, the estimated sensitivity, specificity, positive predictive value, and negative predictive value of lumbar EMG test were 29.2%, 100%, 100%, and 58.5%, respectively, which indicated that using EMG alone is not a good diagnostic criterion due to the low sensitivity of EMG in diagnosis of lumbar spinal canal stenosis in the lumbosacral region [26]. In this study, the clinical tests of EMG and MRI, only in 14 cases, were completely compliant (26.9%). Significant correspondence was found between EMG and MRI related to determining the severity of radiculopathy. However, these tests did not match in terms of diagnosing the presence or absence of abnormality. The sensitivity, specificity, positive predictive value, and negative predictive value for lumbar EMG test were, respectively, 56.4%, 46.2%, 75.9%, and 26.1%. Finally, it seems that the use of this test is not required for diagnosis of lumbar radiculopathy, but, if necessary, it can be left to the discretion of the treating physician. This study showed that lumbar NCV matched with MRI

just in 24.9% of cases and the two tests were statistically concordant neither in diagnosis of presence or absence of lumbar radicular injury nor in determining the severity of damage. Sensitivity, specificity, positive predictive value, and negative predictive value of lumbar NCV test were estimated to be, respectively, 59%, 46.2%, 76.7%, and 27.3%. NCV test results could display the inefficiency of this test in diagnosis of lumbar radiculopathy.

Conclusion

The present study's results supported the hypothesis that diagnostic EMG has a significant value in diagnosis of lumbar and cervical radiculopathy. However, unlike EMG, NCV had insignificant value in diagnosis of lumbar or cervical radiculopathy. Further investigations are needed to evaluate the diagnostic value of two tests by taking some factors into account. Regarding the limited number of studies, it is suggested that comprehensive study be done on NCV diagnostic test, to gain clearer insight into prescribing such a test to the patients.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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